OP 3100. 102. 147

Memorandum No. 780

MINISTRY OF TRANSPORT

Memorandum on the Design of Roads in Rural Areas

(*Superseding Memoranda 653, 715 and Circular 727*)

UNIV LIBRARY OF CAMBRIDGE 28 J 1961

LONDON
HER MAJESTY'S STATIONERY OFFICE
1961
NINEPENCE NET

CONTENTS

Page

1. Introduction 3
2. Traffic Surveys 3
3. Future Growth of Motor Traffic 4
4. Carriageway Capacity 5
5. Traffic Lanes... 5
6. Cycle Tracks... 5
7. Footways 5
8. Central Reserves 5
9. Verges 6
10. Gradients 6
11. Design Speed 6
12. Visibility 6
13. Road Markings at Horizontal and Vertical Curves 7
14. Horizontal Curvature and Superelevation ... 7
15. Junctions 8
16. Kerbs 9
17. Lay-bys and Emergency Stopping Places... ... 10

Design of Roads in Rural Areas

1. *Introduction*

1.1 Memorandum No. 575 entitled Layout and Construction of Roads (1943) is at present under revision and in the meantime it is considered necessary to withdraw the amending Memorandum No. 653(1950) and to substitute the following. The opportunity has also been taken to include with amendments the guidance given in Circular No. 727 (Design of Roads in Rural Areas) and Memorandum No. 715 (Kerbing of Roads in Rural Areas). Memoranda Nos. 653 and 715 and Circular No. 727 are hereby cancelled.

2. *Traffic Surveys*

2.1 In designing new or improved roads, whether in broad outline for purposes of long term planning or in detail for intended early construction, it is essential to have forecast estimates of the traffic volumes for which provision should be made. Normally these forecasts should be based on the observed, or estimated, average daily traffic flow (7 day average 6 a.m.-10 p.m.) in the preceding August with an addition for future growth as recommended in Section 3. The traffic flow should be measured in passenger car units as defined in Section 4.

2.2 The last general census of traffic on the trunk and Class I roads was taken in August, 1954. If these census figures are used as the basis of a traffic estimate a correction should be made to bring them up to the estimated level for the August preceding the preparation of the estimate. The general relationship between traffic volumes in August, 1954, and those in August of a particular subsequent year can be derived from the traffic census appendices in the latter year's issue of the Ministry of Transport and Civil Aviation 'Annual Report on Roads in England and Wales' published by Her Majesty's Stationery Office.

2.3 For a simple scheme, such as a by-pass to a small village, a count of traffic on the existing road, or in some cases counts from the 1954 census adjusted as explained above, will probably give sufficient information since there is unlikely to be any traffic attracted from other routes and few vehicles would require to call in the village.

2.4 For a major scheme an estimate of the current level of traffic which would use the road should be made from the results of an origin and destination survey. If a few years have elapsed since the survey was taken, but the general pattern of traffic distribution has not appreciably altered, the figures should be corrected to the preceding August. A new road or a long by-pass will often attract traffic away from several existing roads so that it is important that the survey should cover all roads likely to be affected by the scheme. The possibility that other projected road developments (for example, the construction of a motorway in the vicinity) may draw traffic away from the route under review should also be taken into account in appropriate cases.

2.5 When an estimate has been made of the traffic to be drawn from (or lost to) other routes, consideration should be given to the possibility of new traffic being generated, for example: by reason of the development of a new town; the location of new industry; or because the new road provides travel facilities which did not previously exist.

3. *Future Growth of Motor Traffic*

3.1 The August traffic flow on trunk and Class I roads, measured in passenger car units, has been increasing in recent years at an average ' compound interest ' rate of 5% per annum. As yet there is no evidence of any appreciable and sustained variation upwards or downwards from that rate and it is therefore recommended that, for the present, highway design should be based on an assumed continuation of the 5% rate into the future. Exceptionally a higher (or lower) figure may be appropriate where there is special reason to expect an appreciably different annual rate of increase in a particular locality.

3.2 Pedal cycle traffic is not expected to increase except locally in the vicinity of factory development; where it is necessary to consider this traffic separately (for example, in relation to the provision of cycle tracks) forecast estimates should be based on assessment of local conditions and trends and not on the general 5% growth rate.

3.3 Figure 1 at the end of this memorandum shows in graph form the time/traffic volume relationship based on the 5% growth rate. For any given carriageway layout and traffic volume, the figure may be used to determine the number of years remaining (the reserve capacity) before the design capacity (see Section 4) of that layout will be reached. It may also be used to determine what carriageway layout will be required to accommodate a given traffic volume plus any specified number of years' traffic growth. For example, it shows that, if on a two-lane carriageway laid out to the standards of this memorandum, traffic has just reached the design capacity of 6,000 p.c.u. per day, improvement to a three-lane carriageway will provide about twelve years' respite before design capacity of 11,000 p.c.u. per day is reached. Similarly the construction of dual two-lane carriageways as soon as single three-lane capacity is reached will cater for a further seventeen years' growth before the provision of further capacity by improvement to dual three-lane layout becomes desirable.

3.4 When designing for early construction, the aim should be to provide a layout having sufficient reserve capacity to make the capital investment in the improvement worth while rather than to provide for growth over an arbitrarily fixed period of years. Where there is doubt about the justification for a layout having a rather low reserve capacity, an economic analysis should be made of the factors involved, including consideration of the economic losses arising from traffic delays during construction. Such an analysis may be particularly necessary where it is proposed to add a third lane to a two-lane road which will later require to be converted to dual carriageway layout. It should not be overlooked that at the cost of some loss of speed and comfort roads can and do carry traffic volumes appreciably above the "design" capacity. For example, if existing traffic volumes on a two-lane road were already appreciably above the design capacity of that layout, overloading might be tolerated for a limited period until it is justifiable to construct a two-lane dual carriageway instead of a three-lane single carriageway which would very soon be loaded up to and beyond its design capacity.

3.5 The intention of this section of the memorandum is not to provide a rigid formula on which the design layout of a particular scheme should be determined but rather to ensure that, when decisions on layout are being taken, due weight is given to the probable economic life of the suggested design capacity, having regard to the expected growth in traffic.

3.6 For long term highway planning it is recommended that provision be made for possible continuation of the 5% growth rate for a minimum period of about 20 years, or (say) a 150% increase on 1959 traffic volumes in passenger car units.

3.7 The foregoing recommendations are based on an assessment of present traffic trends, but the validity of the 5% growth rate, of the 150% addition on 1959 volumes for long term planning and of 1959 as the "datum" year will be kept under review in the light of traffic trends as they may develop in the future.

4. *Carriageway Capacity*

4.1 The design capacity (i.e., the maximum traffic volume for comfortable free-flow conditions) of carriageways laid out to the standards of this memorandum and Memorandum 575 should be taken as follows:—

Two-lane carriageways	6,000 passenger cars per 16 hr. day
Three-lane carriageways	11,000 passenger cars per 16 hr. day
Dual two-lane carriageways	25,000 passenger cars per 16 hr. day
Dual three-lane carriageways	over 25,000 passenger cars per 16 hr. day

4.2 To allow for mixed traffic the equivalent traffic value of various types of vehicles in relation to passenger cars (value=1) shall be taken as follows:—

Category on Enumerators and analysis Census Forms Nos. 638 *and* 639	*Type of vehicle*	*Equivalent value in passenger car units*
1, 2 and 3	Motor cycle	1.0
4 and 5	Private car	1.0
6, 7 and 23	Bus or coach	3.0
8 and 9	Light goods	1.0
10-20	Heavy goods	3.0
22	Pedal cycle	0.5
21	Horsedrawn (these are so few that they may be ignored)	

5. *Traffic Lanes*

5.1 These should have a width of 12 ft. on trunk and important classified roads except on three-lane single carriageways when an overall width of 33 ft. should normally be used. Widths may be less in special circumstances and on Class II and Class III roads where traffic is light.

6. *Cycle Tracks*

6.1 In rural areas cycle tracks should be provided where the average daily number of cycles is likely to exceed 1,000 per 16 hr. day or where there are special circumstances, such as heavy flow over a short period.

7. *Footways*

7.1 There is little justification for providing paved footways in rural areas except in the vicinity of villages or where they would be used to an appreciable extent, but a level verge should, however, always be provided. When purchasing land, carrying out major improvements or safeguarding against development, sufficient land should be taken to enable a footway to be constructed at a later stage, if necessary.

8. *Central Reserves*

8.1 There is no need to make special provision on dual carriageways for the turning of public service vehicles and heavy lorries. Breaks in the central reserve should not be provided for U-turns and should, as far as possible, be restricted to road junctions.

8.2 The following should be the minimum widths of central reserve for roads on new alignments in rural areas:—

Normal site conditions	15 ft.
Sites where geographical, agricultural, or other conditions prevent the desirable overall width from being obtained	10 ft.

8.3 At intersections it is desirable to provide local widening of the central reserve to provide shelter for turning vehicles and cross traffic. When roads are widened on their existing alignment local considerations may necessitate narrower central reserves but they should never be less than 4 ft. wide.

9. *Verges*

9.1 For trunk and important classified roads on new alignments in rural areas, verges should have a minimum width of 12 ft., of which 4 ft. adjacent to the carriageway should be kept clear of footpaths and all obstructions throughout the length of the road. The 12 ft. dimension can be reduced to 9 ft. on and under bridges. A level verge assists visibility and also provides a space onto which snow can be thrown.

10. *Gradients*

10.1 A gradient of 1 in 25 (in lieu of 1 in 30 specified in Memo. 575) should ordinarily be regarded as the maximum, but in hilly country a steeper gradient may have to be adopted. Where gradients steeper than 1 in 25 occur on important trunk and classified roads with single two-lane carriageways, an extra lane for ascending traffic should be provided wherever possible. Where the gradient is long or where there is much heavy slow-moving traffic, an extra lane may be justified for lesser gradients than 1 in 25.

11. *Design Speed*

11.1 Design speed is the speed used for correlating the design features to give a uniform standard of comfort and safety in driving along a road.

11.2 The design speeds for new construction and for improvement of existing trunk and classified roads should, where possible, be as follows:—

(a) Dual carriageways	70 m.p.h.
(b) All 33 ft. single carriageways and trunk and class I 24 ft. single carriageways	60 m.p.h.
(c) Other classified roads with two-lane single carriageways ...	50 m.p.h.

These design speeds may not always be justified on economic grounds in difficult country, on existing roads, or on roads of low traffic importance: in these cases lower values may have to be adopted.

12. *Visibility*

12.1 Visibility distances, both vertical and horizontal, should be measured between points 3 ft. 9 ins. above the carriageway on the centre line of the carriageway.

12.2 On single carriageways sufficient visibility should be provided for overtaking on as much of the road as possible, especially where the volumes are expected to approach the limiting values given in para. 3. Recommended minimum overtaking visibility distances are shown in the following table. Where on economic grounds it is not justifiable to obtain these overtaking visibility distances, the visibility should nowhere be less than the minimum stopping distances as shown in the table.

	Visibility distances (feet)	
Design Speed m.p.h.	*Minimum overtaking (single carriageways)*	*Minimum stopping (Single and dual carriageways)*
70	—	950
60	1,400	650
50	1,200	425
40	950	300

13. *Road Markings at Horizontal and Vertical Curves*

13.1 These should be laid in accordance with the recommendations contained in Circular No. 764 issued to highway authorities on 5th April, 1960.

14. *Horizontal Curvature and Superelevation*

14.1 Curves should be laid out with the largest practicable radius. Superelevation should normally be 1 in $\frac{37r}{V^2}$ and never steeper than 1 in 14½ or flatter than the normal crossfall for the road. In all cases curves should be designed by choice of road radius and superelevation so that $\frac{V^2}{15r} - \tan x$ does not exceed 0.15 where V is the design speed in m.p.h., r the radius of the curve in feet and tan x the superelevation.

14.2 Adverse crossfall or camber should be eliminated on all curves up to 11,000 ft. radius so that there is uniform crossfall towards the inside of the curve. This is particularly important on layouts where the normal crossfall on straights is uniform across the whole width of the carriageway. On curves of radius greater than 11,000 ft., the elimination of adverse crossfall is not essential, but on long curves it might be desirable on aesthetic grounds.

14.3 With the maximum superelevation the radius of curvature should never be less than the figures shown in the last column of the following table. Where economically possible the radius should exceed the minimum desirable value given in the second column of the table.

Design Speed m.p.h.	*Desirable radii feet*	*Absolute minimum radii with 1 in 14½ superelevation feet*
70	Not less than 2,800	1,500
60	,, ,, ,, 2,100	1,100
50	,, ,, ,, 1,450	750
40	,, ,, ,, 900	500

14.4 For roads with 12 ft. lanes and radii sharper than 500 ft. the carriageway should be widened by 1 ft. for each traffic lane. Where lane widths are less than 12 ft. in the circumstances stated in section 4, and where physical conditions render unavoidable the use of curves of sharper radius than 1,500 ft., the normal width of each traffic lane should be increased by 1 ft., this allowance to be increased to 1½ ft. for each traffic lane where the radius is less than 1,000 ft.

and 2 ft. where the radius is less than 500 ft. Such added width should be obtained by widening the carriageway at an approximately uniform rate along the length of the transition curve. In the improvement of existing curves the widening should generally be made on the inside of the curve. Three-lane carriageways marked into two lanes at curves do not require such widening.

14.5 Transition curves should be provided on all curves of which the radius is less than the figure shown in the table below against the design speed for the road.

Design Speed m.p.h.	*Transition Curve to be provided when curvature radius less than feet*
70	5,000
60	5,000
50	4,000
40	2,500

15. *Junctions*

15.1 At junctions where the minor road is of insufficient importance to justify such forms of treatment as e.g. roundabouts, grade separation etc., there should be full visibility both to the right and to the left between points 3 ft. 9 in. above road level over areas defined by:—

(a) a line 50 ft. long along the centre line of the minor road from the continuation of the line of the nearer edge of the carriageway of the major road;

(b) a line of the length given in the table below measured along the nearer edge of the major road carriageway from its intersection with the centre line of the minor road;

(c) the straight line joining the terminations of the above lines.

Design speed of major road m.p.h.	*Minimum visibility distance (feet)*	
	Dual Carriageway	*Single Carriageway*
70	700	850
60	600	725
50	500	600
40	400	475

15.2 Unless it is obvious to a driver that he is approaching a major road a "Slow—Major Road Ahead" sign should be provided in the minor road.

15.3 Diagrams 1 and 2 of Memorandum No. 575 are superseded by the above: but the principle of staggering minor roads should continue to be used in appropriate circumstances. A stagger of 120 ft. between the minor roads has been found to be satisfactory, but less separation may be unavoidable in particular cases.

15.4 D-type junctions of the types shown in Diagrams 3, 4 and 5 of Memorandum No. 575 are not now recommended; until further guidance can be given, designs should be made with regard to the traffic movements expected and on the merits of the case, but general principles of design are as follows:—

(a) The number of junctions with the major road should be kept to a minimum.

(b) Equal attention should be paid to entry to and exit from the major road.

(c) Layouts should be so arranged that the speeds of traffic streams which are merging (or which are diverging) are about equal. Acceleration and deceleration lanes may be appropriate for this purpose.

(d) The layout should enable the right-hand exit from a major road to be made obliquely.

(e) To help the driver's view along the major road the layout should be such that the manoeuvre of emerging from the minor road and turning right should not be made at too oblique an angle.

(f) The driver on the minor road should be made aware of the major road ahead and prevented from making a direct crossing.

(g) Carriageway markings and traffic signs should be used to guide drivers into the desired paths.

(h) Where possible the carriageway should be widened, so that an extra lane can be provided to accommodate vehicles waiting to make the right-turn.

16. *Kerbs*

16.1 On through routes continuity and uniformity of practice in kerbing is highly desirable.

16.2 Vertical kerbs should be provided only where a footway adjoins, or is close to the carriageway and is used to an appreciable extent, or where for some other reason it is dangerous for vehicles to leave the carriageway. Raised kerbs, and particularly vertical kerbs, can induce "kerb shyness" and thus reduce the effective width of the carriageway.

16.3 Where a vertical kerb is not required but some form of kerbing is necessary (e.g. to support or to define the edge of the carriageway) flush or splayed kerbs should be used.

16.4 Where flush kerbs are provided, it will generally be desirable to harden the verge for a limited width behind the kerb in order to prevent damage to the road structure from rutting by vehicles over-running the kerb. The width of this hardening will depend upon such factors as the type and volume of traffic, width of carriageway and prevalence of fog, but need not exceed 4 ft. 6 in. On many roads a lesser width may be adequate and, in particular cases where the material in the verges is of specially good quality, additional hardening may not be required.

16.5 Kerbs serve as a useful visual guide and aid to movement especially at night and in areas subject to fog. For adequate visibility of flush kerbs by night in wet weather colour contrast alone is not sufficient and a texture contrast should therefore also be provided. A very coarse-textured edge marking of a light colour gives the best contrast.

16.6 The provision of a corrugation or ripple on the surface of the flush kerb, so designed as to make the driver conscious of the fact that the near side wheels have left the running surface of the carriageway, may assist in preventing over-running of the kerb, but should not be regarded as an alternative to making the kerb adequately visible. In one experiment which gave promising results ½-inch deep depressions were formed in the surface of the flush kerb at about 10 ft. intervals, but further experiments will be carried out to determine the most effective arrangement.

16.7 Where raised kerbs (whether splayed or vertical) are installed, a height of 4 inches between the surface of the carriageway adjoining the kerb and the top of the kerb is sufficient and this height should not normally be exceeded.

16.8 The above does not apply to selected sites provided with kerbs especially designed to restrain vehicles from leaving the carriageway at specially dangerous places.

16.9 Experiments are being continued with flush kerbs to determine how best to provide adequate night-time visibility combined with durability of the marking. Investigations are also being made into the possible use of red reflectors to delineate carriageway boundaries.

17. *Lay-bys and Emergency Stopping Places*

17.1 Places where cars can stop off the carriageway on suitably hardened areas and paved lay-bys for all vehicles should be regarded as an essential part of the design of rural roads. In addition, sufficient space for waiting off the carriageway should also be provided at points of scenic interest.

17.2 Lay-bys should, where possible, be located at approximately equal intervals alternately on either side of the road. Where this is not possible and lay-bys are in pairs they should be intervisible and should be staggered so that emerging vehicles draw away from one another. The distance between lay-bys on the same side should not exceed that shown in the table below. Lay-bys should not be located on the inside of a bend nor run into a junction or exit road and should never be in the central reserve of a dual carriageway.

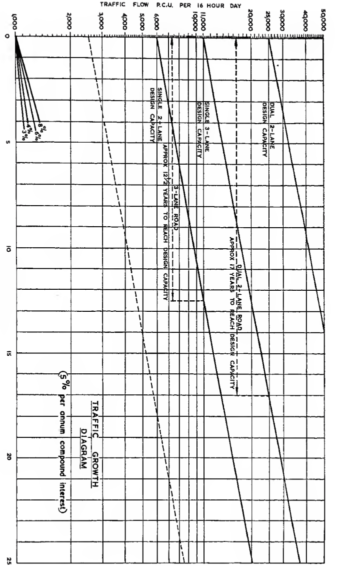
Up to 4,500 passenger car units per day	from 3-2 miles apart.
4,500-9,000 passenger car units per day	from 2-1 miles apart.

17.3 For volumes of traffic over 9,000 passenger car units regard should be had to closer spacing or increasing the length of the lay-bys.

17.4 In hilly country lay-bys at the lowest points of gradients are of special advantage in cases of the breakdown of vehicles. Whenever possible, advantage should be taken of short sections of disused or abandoned carriageway to serve as lay-bys. Lay-bys are not intended for omnibus stopping places; in certain places it may be desirable to construct stopping places off the main carriageway specifically for omnibus traffic.

17.5 The length of a lay-by should be determined by the volume and character of the traffic on the road, but the length should not be less than 100 ft. On important roads this length should be increased according to the number of vehicles to be accommodated. In addition suitable connections should be made at each end to enable vehicles to leave and rejoin the main carriageway with ease and safety. The width of a lay-by should normally be 10 ft. and in no case should it be less than 8 ft. On important trunk and classified roads the width should be increased to 12 ft. An intermittent standard white line with 3 ft. markings and 3 ft. gaps should be provided at the junctions of the lay-by with the carriageway. It may also be advantageous to make the surface of the lay-by a different colour from that of the adjacent carriageway. The surface should be as attractive as that on the main carriageway.

17.6 Continuous hard shoulders on to which vehicles can, in emergency, draw off clear of the carriageway are not normally required on all-purpose roads. Exceptionally (e.g. where the road forms a direct continuation of a motorway, or where the layout of the road and the behaviour of traffic give rise to conditions comparable with those on a motorway), it may be necessary to provide full hard shoulders, but any cases of this kind should be considered on their particular merits and circumstances.


TRAFFIC FLOW P.C.U. PER 16 HOUR DAY
1,000
2,000
3,000
4,000
5,000
6,000
10,000
11,000
20,000
25,000
30,000
40,000
50,000
0
5
10
15
20
25
PERIOD OF YEARS
8%
6%
4%
3%
SINGLE 2-LANE DESIGN CAPACITY
SINGLE 3-LANE DESIGN CAPACITY
DUAL 2-LANE DESIGN CAPACITY
3-LANE ROAD APPROX 12½ YEARS TO REACH DESIGN CAPACITY
DUAL 2-LANE ROAD APPROX 17 YEARS TO REACH DESIGN CAPACITY
TRAFFIC GROWTH DIAGRAM
(5% per annum compound interest)